

**Amendment and Response**

Applicant: Hong-Jyh Li

Serial No.: 10/816,503

Filed: April 1, 2004

Docket No.: Q331.128.101/2004P51130US

Title: PLASMA ION IMPLANTATION SYSTEM

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**REMARKS**

The following remarks are made in response to the Non-Final Office Action mailed May 28, 2008. Claims 1, 4-9, 12-25, and 28-31 were rejected. With this Response, claims 1, 8, 15, 16, 21, 22, and 25 have been amended, claims 13, 14, and 20 have been cancelled, and claims 32 and 33 have been added. Claims 1, 4-9, 12, 15-19, 21-25, and 28-33 remain pending in the application and are presented for reconsideration and allowance.

**Claim Rejections under 35 U.S.C. § 103**

The Examiner rejected claim 1 under 35 U.S.C. § 103(a) as being unpatentable over Koezuka, U.S. Patent No. 6,995,079 (“Koezuka”) in view of Jeon, U.S. Patent No. 6,790,755 (“Jeon”).

Applicant submits that Koezuka and Jeon, either alone, or in combination, fail to teach or suggest the limitations recited by amended independent claim 1 including **wherein the voltage source is configured to attract ions to implant in a buffer layer of the sample, the buffer layer proximate the high-k dielectric layer.**

**Koezuka** discloses an ion implantation apparatus. (Col. 3, lines 21-40, and Fig. 2).

**Jeon** discloses a layered dielectric structure comprising an alternating pattern of at least two sub-layers of a first dielectric material which is a high-K dielectric material and at least one layer of a second dielectric material which is a standard-K dielectric material, wherein at least one of the one or more second dielectric material sub-layers contain nitrogen implanted therein using a nitridation step. (Abstract).

The Examiner admits that Koezuka and Jeon fail to teach the use of a buffer layer. The Examiner submits that Yamada teaches a buffer layer 6. (Office Action, page 5).

**Yamada** discloses a bipolar transistor. Yamada discloses a buffer layer 6 containing a p-type impurity on the protrusion on the SOI layer of the “transverse arm portion” and making the p<sup>+</sup>-type layer external base region 9 by diffusion from the buffer layer. (Para. 0128). Yamada discloses that after the polysilicon layer 6 is stacked as the buffer layer, boron (B) is doped by ion implantation. (Para. 0141).

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Yamada fails to disclose a buffer layer *proximate the high-k dielectric layer*. In contrast, Yamada discloses the buffer layer 6 is proximate an external base region 9. In addition, Yamada fails to disclose implanting the buffer layer with ions comprising one of F, Si, O, Hf, Zr, Ti, Ta, Y, V, Sc, Ba, Sr, Ru, Al, Ga, In, Ge, C, and Sb. In contrast, Yamada discloses the buffer layer 6 is implanted with B, which is not one of the ions recited by claim 1. Therefore, it would not have been obvious to one of ordinary skill in the art to combine the ion implantation apparatus disclosed of Koezuka, the nitridation step disclosed by Jeon, and the buffer layer disclosed by Yamada to implant a buffer layer proximate the high-k dielectric layer as recited by independent claim 1.

In view of the above, Applicant submits that the above rejection of independent claim 1 under 35 U.S.C. § 103(a) should be withdrawn. Allowance of claim 1 is respectfully requested.

The Examiner rejected claims 4-9, 12, 16-19, 25, and 28-30 under 35 U.S.C. § 103(a) as being unpatentable over Koezuka, in view of Jeon, and further in view of Collins, U.S. Patent No. 6,518,195 ("Collins").

Dependent claims 4-7 further define patentably distinct independent claim 1. Accordingly, Applicant believes that these dependent claims are also allowable over the cited references. Allowance of claims 4-7 is respectfully requested.

Applicant submits that Koezuka, Jeon, and Collins, either alone, or in combination, fail to teach or suggest the limitations recited by amended independent claim 8 including **wherein the sample comprises a buffer layer proximate the high-k dielectric layer, and wherein the DC voltage source is configured to accelerate positive ions toward the buffer layer of the sample to implant the positive ions in the buffer layer.**

The Examiner admits that Koezuka, Jeon, and Collins fail to teach the use of a buffer layer. The Examiner submits that Yamada teaches a buffer layer 6. (Office Action, page 5).

For similar reasons as discussed above with reference to independent claim 1, Applicant submits that Yamada also fails to teach or suggest these limitations recited by independent claim 8.

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In view of the above, Applicant submits that the above rejection of independent claim 8 under 35 U.S.C. § 103(a) should be withdrawn. Dependent claims 9 and 12 further define patentably distinct independent claim 8. Accordingly, Applicant believes that these dependent claims are also allowable over the cited references. Allowance of claims 8, 9, and 12 is respectfully requested.

For similar reasons as discussed above with reference to independent claim 8, Applicant submits that Koezuka, Jeon, and Collins, either alone, or in combination, also fail to teach or suggest the limitations recited by amended independent claim 16 including **wherein the voltage source is configured to accelerate positive ions toward a buffer layer of the sample adjacent the first high-k dielectric layer to implant the positive ions in the buffer layer.**

In view of the above, Applicant submits that the above rejection of independent claim 16 under 35 U.S.C. § 103(a) should be withdrawn. Dependent claims 17-19 further define patentably distinct independent claim 16. Accordingly, Applicant believes that these dependent claims are also allowable over the cited references. Allowance of claims 16-19 is respectfully requested.

For similar reasons as discussed above with reference to independent claim 8, Applicant submits that Koezuka, Jeon, and Collins, either alone, or in combination, also fail to teach or suggest the limitations recited by amended independent claim 25 including **positioning a sample comprising a high-k dielectric layer and a buffer layer adjacent the high-k dielectric layer on a sample holder in a vacuum chamber; and accelerating positive ions in the plasma toward the sample to implant the positive ions in the high-k dielectric layer and in the buffer layer while repelling negative ions from the sample.**

In view of the above, Applicant submits that the above rejection of independent claim 25 under 35 U.S.C. § 103(a) should be withdrawn. Dependent claims 28-30 further define patentably distinct independent claim 25. Accordingly, Applicant believes that these dependent claims are also allowable over the cited references. Allowance of claims 25 and 28-30 is respectfully requested.

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The Examiner rejected claims 13-15 and 20-24 under 35 U.S.C. § 103(a) as being unpatentable over Koezuka, in view of Jeon, further in view of Collins, and still further in view of Yamada, U.S. Patent Publication No. 2001/0054746 ("Yamada").

Dependent claims 13, 14, and 20 have been cancelled. Dependent claims 15 and 21-24 further define patentably distinct independent claim 8 or 16. Accordingly, Applicant believes that these dependent claims are also allowable over the cited references. Allowance of claims 15 and 21-24 is respectfully requested.

In addition, Applicant submits that Koezuka, Jeon, Collins, and Yamada, either alone, or in combination, also fail to teach or suggest the further limitations recited by dependent claim 22 including **wherein the buffer layer comprises a stack of layers**. In contrast, buffer layer 6 of Yamada is a single layer.

The Examiner rejected claim 31 under 35 U.S.C. § 103(a) as being unpatentable over Koezuka, in view of Jeon, further in view of Collins, and still further in view of Wu, U.S. Patent No. 6,248,662 ("Wu").

Dependent claim 31 further defines patentably distinct independent claim 25. Accordingly, Applicant believes that this dependent claim is also allowable over the cited references. Allowance of claim 31 is respectfully requested.

In addition, Applicant submits that Koezuka, Jeon, Collins, and Wu, either alone, or in combination, fail to teach or suggest the further limitations recited by dependent claim 31 including **wherein accelerating positive ions in the plasma toward the sample to implant the positive ions in the sample comprises accelerating the positive ions to have an implant energy greater than 5eV and less than 10keV**.

The ions recited by claim 31 include F, Si, O, Hf, Zr, Ti, Ta, Y, V, Sc, Ba, Sr, Ru, Al, Ga, In, Ge, C, and Sb. In contrast, Wu only discloses BF<sub>3</sub> and the energy of the implanted ions disclosed is specific to BF<sub>3</sub>. (Col 3, lines 15-17). Therefore, it would not have been obvious to one of ordinary skill in the art to combine the ion implantation apparatus disclosed of Koezuka, the nitridation step disclosed by Jeon, the DC bias disclosed by Collins, and the implant energy specific to BF<sub>3</sub> as disclosed by Wu to implant the positive ions (none of which are BF<sub>3</sub>) in the

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sample with an implant energy greater than 5eV and less than 10keV as recited by dependent claim 31.

**Added Claims**

Claims 32 and 33 have been added. Dependent claims 32 and 33 further define patentably distinct independent claim 1 or 8. Accordingly, Applicant believes that these dependent claims are also allowable over the cited references. Allowance of claims 32 and 33 is respectfully requested.

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**CONCLUSION**

In view of the above, Applicant respectfully submits that pending claims 1, 4-9, 12, 15-19, 21-25, and 28-33 are in form for allowance and are not taught or suggested by the cited references. Therefore, reconsideration and withdrawal of the rejections and allowance of claims 1, 4-9, 12, 15-19, 21-25, and 28-33 is respectfully requested.

No fees are required under 37 C.F.R. 1.16(h)(i). However, if such fees are required, the Patent Office is hereby authorized to charge Deposit Account No. 50-0471.

The Examiner is invited to contact the Applicant's representative at the below-listed telephone numbers to facilitate prosecution of this application.

Any inquiry regarding this Amendment and Response should be directed to Mark A. Peterson at Telephone No. (612) 573-0120, Facsimile No. (612) 573-2005. In addition, all correspondence should continue to be directed to the following address:

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Respectfully submitted,

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